

The Dilated Times

The newsletter of the Drew University Society of Physics Students

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Editor: Michael Jokubaitis

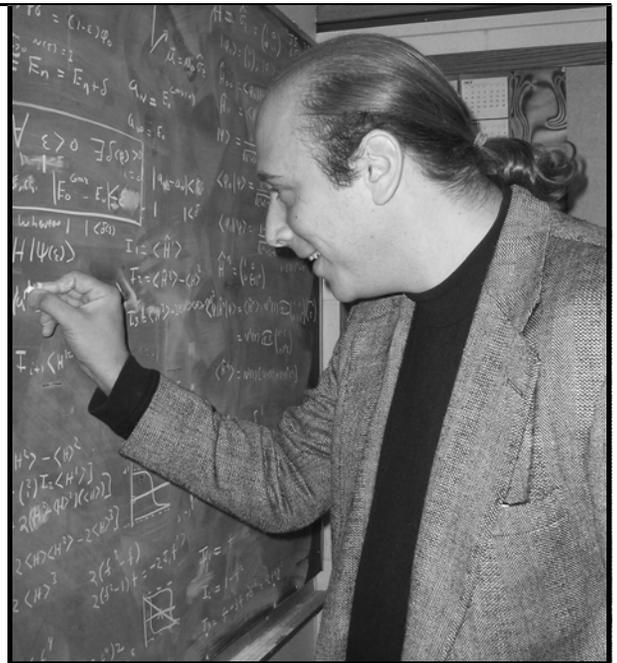
Welcome to Drew, Dr. Murawski!

By Laura Barclay '08

Last Spring, Dr. Robert K. Murawski was chosen for a one-year visiting assistant professor of physics position here at Drew for 2007-08. Dr. Murawski earned a B.S. in physics at Fordham University, Rose Hill campus in the Bronx before earning a M.A. in mathematics at the City College of New York (part of the CUNY system). He then earned a Ph.D. in physics at Stevens Institute of Technology in Hoboken, NJ, but feels that he did not end his education there. Afterwards, Dr. Murawski completed a post-doc at Texas A&M in College Station, Texas, and Princeton University. Dr. Murawski highly recommends Stevens as a great choice for graduate school, since the department is small and friendly, much like our department at Drew. However Texas A&M has the advantage of more choices of specialization, since Texas A&M boasts around 70 faculty members and 40 research scientists.

During graduate school Dr. Murawski began to feel that he would want to work at a small liberal arts college where the emphasis was on teaching, with freedom to do research. Fordham University, his undergraduate alma mater, has a very small physics department which graduated only five other physics majors in the year that Dr. Murawski graduated. That experience greatly influenced his decision. Years before he applied to work at Drew, Dr. Murawski learned about the school through Dr. James Supplee. In addition to being a professor here at Drew, Dr. Supplee has a visiting position at Stevens Institute and used to work with one of Dr. Murawski's former professors. Dr. Supplee was an in-

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Dr. Murawski unraveling the mysteries of Electrodynamics

NSF Director Visits Drew

By Michael Jokubaitis '10

On Monday October 15th, Dr. Arden L. Bement, Director of the National Science Foundation (NSF), and Congressman Rodney P. Frelinghuysen, along with several other members of the NSF, the mayor of Madison, and teachers and professors from local schools and other universities, came to Drew University to meet the faculty and students and to view the science programs. The importance of the relationship between the sciences at Drew and the NSF cannot be overstated. In the Physics Department the research efforts of Dr. David McGee are funded in large part by the NSF and many participants in the Drew Summer Science Institute (DSSI) are supported in their work by NSF grants.

The day began at 9:30 in the morning with a reception in the Hall of Sciences rotunda where Congressman Frelinghuysen, Dr. Bement, and the other visitors had a chance to meet with the faculty of the Anthropology, Biology, Chemistry, Mathematics and Computer Science, Physics, and Psychology departments and to view several of the DSSI poster presentations created by participants in this past summer's DSSI. Students were on hand to explain their projects and to explain the importance of the NSF in their work. At 10:00 the visitors, faculty, and students moved into HS-4, the large amphitheatre-style lecture hall, to

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Welcome to Drew, Dr. Murawski!

valuable source of information about what it is like to teach at a four year school.

The first things Dr. Murawski noticed upon his arrival at Drew were the beauty of the campus and the way that he was welcomed during faculty orientation. Although the process was rather lengthy, he left with the sense that he was part of something and that he belonged here. Dr. Murawski elaborated, "The administration here have made great efforts to make new people feel welcomed. Additionally, shortly after I arrived here, Dr. Fenstermacher invited my wife and me to dinner at his home. That kind of thing is great. I also liked the fact that Dr. Fenstermacher does SPS barbeques at his house. All these things have been very positive. Dr. Murawski also appreciates that Drew has a requirement that each professor must teach only five courses a year, which as he pointed out, leaves plenty of time to conduct research during the semesters with only two courses. He is glad that Drew also has a Theological school, stating, "You know what Einstein said, 'Science without religion is lame. Religion without science is blind.'" As for the physics department in particular, Dr. Murawski's first impression was that the department is a family, and Dr. Fenstermacher is the pater familias. As Dr. Murawski explained, "You can just tell that his vision has shaped the department. I think it's great that the department is small and friendly, that all the students know each other and all the professors know the students by name. You are not going to get that

kind of experience at a large school."

Because this semester is his first experience with a full time teaching position rather than full time research, he views it as a phase transition, and has really enjoyed the challenge. This fall he has been teaching Introductory Physics (PHYS 1), Introductory Lab, and Electrodynamics, and has been enjoying all of them. He enjoys teaching the broad spectra of topics covered in Introductory Physics, as well as the opportunity for impressing the students with various demonstrations. He has been trying to make time for at least one demo per week. Because Dr. Murawski feels at home with lab equipment and enjoys the immediate feedback from students that arises in a lab setting, he also has an appreciation for teaching Introductory Lab. However, Electrodynamics is a subject he has loved since he himself was an undergraduate student, and so he views it as a real treat to teach. Dr. Murawski summed up his first impression of teaching here at Drew, "All the physics majors are serious about their classes and that is important. That's all a teacher could ask for: motivated students." When asked if we students have driven him crazy yet while he is in his office, Dr. Murawski replied, "I was hoping students would stop by more often. Like I mentioned, I love discussing physics, so bring me your questions (or answers)." Oh we will, Dr. Murawski! Thanks for being so friendly, and welcome to Drew!

Summer Research and Jobs: A Retrospective

PPPL Experience

By Dave Newby '08

This summer I participated in the National Undergraduate Fellowship in Plasma Physics and Fusion Energy Sciences at the Princeton Plasma Physics Lab. The NUF program, as it is called, is sponsored by the Department of Energy and serves to ignite interest (no pun intended) in fusion and plasma physics. The ten week duration of the program was a great experience overall, and I would highly recommend it to anyone looking for an internship.

The program itself consists of one week of lectures followed by nine weeks of research. Since many of the fellows (such as myself) enter the program with no prior experience in plasma science, the week of lectures was a really great way to kick off the summer. Four 2-hour lectures a day for four days, and one day of a hands-on lab followed by a tour of the facilities can really take it out of you, but by the end we were all ready and raring to get researching.

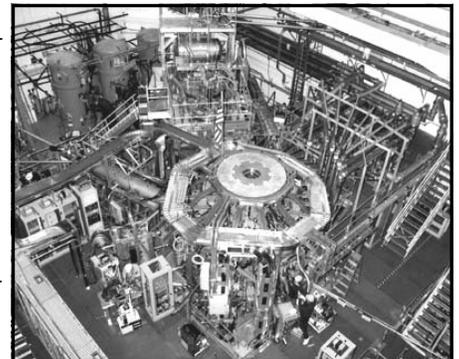
The ensuing nine weeks of research were something totally new for me. I've done experimental research in the past, but this turned out to be entirely data analysis using a computer program that I'd never even heard of. Using the IDL programming language, my advisor (Dr. Jill Foley of Nova Photonics) set me to the task of analyzing two years worth of data from a particular diagnostic on the National Spherical Torus Experiment (NSTX). The data that I was looking at provides much information about the magnetic fields and their evolution during a plasma

discharge. If functioning fusion reactors are ever to be built for the purpose of extracting energy to use as electricity, we need to have a good fundamental understanding of the instabilities and disruptions that can take place inside of one. It was very exciting to be the first one to thoroughly examine a set of data taken from such a huge and well-known experiment.

In making observations about the plasma's magnetic fields I came across an interesting phenomenon known as a sawtooth instability. This instability has not yet been studied with the diagnostic that is on the NSTX, and I am currently pursuing the work as an honors thesis at Drew.

At the end of the nine weeks of research, every student in the program had to give a ten minute presentation to the rest of the group. It was interesting to see other people's research and hear researchers from the lab asking questions. It was even more enlightening to have to prepare such a presentation myself and deliver it to the largest audience I've ever spoken in front of.

The NUF program was a great summer experience, and I would definitely recommend that undergraduate physics majors apply.



PPPL, NSTX Tokamak



2007 DSSI

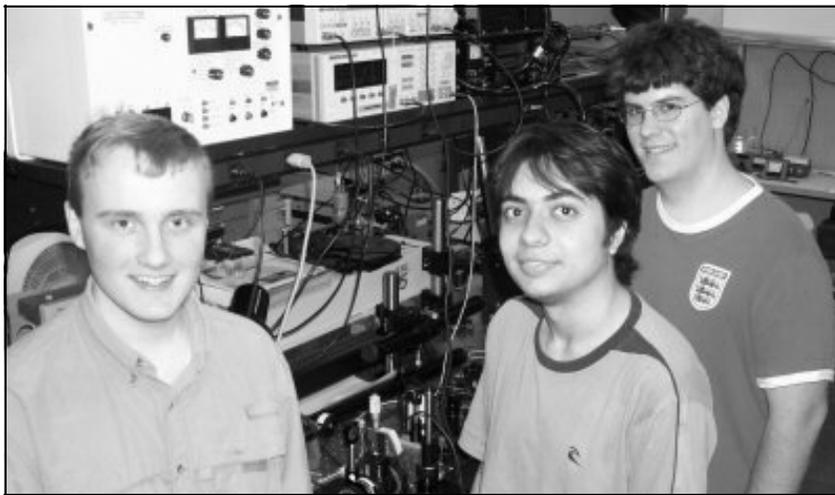


by Dr. David McGee

Summer 2007 marked another successful Drew Summer Science Institute. Twenty-five students representing all departments in Division I were paid full-time stipends to work with faculty mentors on a variety of research projects. The physics department was well represented with four students working under the direction of Professor McGee and his collaborators. Physics majors Michael Jokubaitis, Brian Kelly, and Varun “Mac” Makhija worked at Drew in McGee’s lab, while chemistry major Kimy Yeung worked at the University of Wisconsin Nanoscale Science and Engineering Center (NSEC) with McGee’s collaborator Padma Gopalan.

All students continued our ongoing research in lasers, nonlinear optics, and novel optical materials. This summer was particularly exciting as we added two new experiments on the characterization of optical materials, a new instructional lab on laser physics, and explored new synthetic routes for highly electro-optic organic dyes.

As always, the summer starts with intensive LabVIEW tutorials. LabVIEW is a popular graphical programming language for computer control and data acquisition of experiments. Mac came to summer research after completing the physics department Advanced Lab course, so he was already proficient in LabVIEW. He helped Michael and Brian quickly get up to speed, so that they could focus on making progress in the optics lab.



From left to right: Michael Jokubaitis, Varun “Mac” Makhija, and Brian Kelly

Michael’s main project was building an open-cavity HeNe laser. This is a gas-filled laser tube with a fixed rear mirror and a movable front mirror, making it basically an adjustable-length laser. Since the beat frequency of adjacent laser modes is a simple function of cavity length and the speed of light c , Michael was able to measure c via fast Fourier spectral analysis of the laser output as a function of length. The experiment involved basic skills in optical alignment and high-speed electronics, and we are hoping to incorporate this as an Advanced Lab experiment in the near future.

Brian Kelly continued his Spring 07 Independent Study project on the fabrication of electro-optic polymer films into the summer, and broadened it to include a study of their resistance to photodegradation. Brian focused on trying to measure the change in a polymer’s transmission after long-term exposure to laser light, and calculating a figure of merit that would allow us to compare the relative robustness of various polymer compositions. The films of interest are quite transparent to begin with, which means that Brian had to look for very subtle changes in transmission over long irradiation times. He has since become expert in tracking down external noise sources that would bury the signal of interest.

Mac continued the work begun by Ethan Marsh on second harmonic generation in poled polymer films. In this experiment, a pulsed near-infrared laser irradiates a polymer film, which then generates light at half the wavelength, in the green portion of the spectrum. The intensity of this so-called second harmonic depends on the degree of molecular order. It is quite weak, and is measured with a photomultiplier. Mac modified the experiment to measure the second harmonic as a function of time and temperature, giving him a way to compare molecular alignment among various polymer configurations. Using MathCAD to model this process will allow Mac to determine the nonlinear optical coefficients of the polymers.

In September, the physics department DSSI students presented their work at the Fall Poster Session, which was well attended by students, parents, and faculty. Michael and Brian are now continuing their DSSI work as Independent Study projects, while Mac is continuing his work as an honor’s thesis. As always, if you are interested in learning more about DSSI, be sure to contact Dr. McGee.

Thank You to William Clark

As he has done for four previous summers, physics alum William Clark ‘91 has generously provided yet another summer of financial support for Drew Summer Science Institute students. This summer, physics majors Michael Jokubaitis, Brian Kelly, and Varun “Mac” Makhija worked full-time in Dr. McGee’s lab with stipend assistance provided by Mr. Clark. To learn more about the exciting work of these students, see the article “2007 DSSI” in this issue of the Dilated Times. Once again, thanks Bill; we could not do this without your help!

A Summer at the Governor's School

By Evan Kimberly '08

This past summer I was given the opportunity to work as a counselor for the New Jersey Governor's School in the Sciences. Initially I wasn't entirely sure what to expect, but upon arrival I was instantly surrounded by some of the smartest kids I have ever worked with. All of the students, typically entering their senior year in high school in the fall, apply to enter the program and rank in the top of their classes in their respective high schools. They were amazing in class, always asking intelligent questions and stumping guest speakers, even after apparently falling asleep during the lectures. My work entailed living in the dorm with them, acting as an RA, as well as being a TA during their classes, labs, and team projects. I ended up working primarily in the modern physics class, the electronics lab, and the team project titled "the physics of popcorn." This project consisted of taking data based on the theory that a lower surrounding pressure will increase popcorn kernel size. The students, along with the professor, Dr. Paul Quinn '94, derived the equation from the ideal gas law for adiabatic processes, and ended up getting a lot of good data that will actually be used on Dr. Quinn's patent application! All in all, it was a great experience to be with these kids for a month. Although it was not a specific research experience, I learned a lot and took away much that will help me in my future science work.



Some Physics Humor

Humorous Quotes from the World of Electrodynamics Class

- "They're trying to kill each other, and the metal's like Sweden!"
(Evan, on two charges in cavities in a conductor, confusing Sweden with Switzerland.)
- "I'm having trouble believing that all of this is really necessary."
-Kyle, on a derivation covering the entire board.
- "If I could marry an integral..." -Dr. Murawski, on Fourier's Trick
(Pointing to a hideous differential equation)
- "If you were on the street and you saw this, what would you do?" -Dr. M.
"Walk away." - Kyle
- "Ethan? That's the gentleman who graduated last year?" -Dr. M.
"Well, I wouldn't go so far as to say 'gentleman'..." -Evan

Three Physics Students' DSSI Experiences

Photostability In Optical Polymers

By Brian Kelly '09

This summer, I had the good fortune to work with Dr. McGee in the optics lab, with the help of the Drew Summer Science Institute. The majority of my summer was spent working on restoring the photostability experiment to working order, and starting to take measurements again, after a break in operation last year. As I am learning, the world of research is rarely smooth, and things rarely perform as planned. Between other experiments needing lab time, and mystery signals that took months to eliminate, we did not take as many reliable data runs as I hoped. However, I have learned a valuable lesson about research: look harder, chances are the solution is there.

I was new to research before this summer. A few final exam projects in high school and the Physics 11 lab were the limit of my applied scientific experience. I had no idea what to expect when I arrived at Drew for the summer. In classes and labs, results are clear and easy to get. This summer, though, was a test in troubleshooting. Everything from signals falling when they should rise (traced to resonance in an attenuator) to periodic oscillations when we expected a straight line (attributed to grounding issues) plagued us, delaying solid results. However, careful analysis and discussions of theory led to solutions, and now the experiment is ready to start again, and I hope, error-free.

Despite setbacks, this experience was extremely valuable to me. It combined learning techniques to limit error, troubleshooting what error we did see, and ultimately correcting mistakes we managed to locate. While trustworthy data proved to be elusive, the skills and knowledge taught to me by Dr. McGee and hands-on experience means that both the future of the experiment, and my competence in laboratory work, looks bright.

Second-Harmonic Generation

By Varun "Mac" Makhija '08

This summer, I worked in Dr. McGee's lab where I studied a number of nonlinear optical effects - effects that depend on the intensity of light incident on a certain medium. Generally, light that passes through a medium can exit at a different frequency than that at which it entered. You're probably wondering why you don't see this effect happening everyday and if the laws of conservation of energy are being violated. First, it's unlikely that the light you're around everyday is intense enough to make these effects occur with enough intensity to be noticed relative to linear effects. Second, energy is conserved, but the number of photons is not. For instance, a molecule may absorb two infrared photons, and emit one green photon.

Second Harmonic Generation is the specific nonlinear effect I studied. This effect is a second order effect meaning that it involves two photons. It is also called frequency doubling. Light traveling through the medium doubles its frequency. This, and second order effects in general, depend on the configuration of the system. In our case, we are studying how the intensity of second harmonic light varies with the temperature of the medium. This is a general question, and varies with the nature of the medium. In our case the medium is an organic thin-film. The films are composed of polymer chains with dye molecules 'thrown' in. A single dye molecule will absorb two photons of equal energy and emit one of double the energy if you bombard it with enough photons. However, this occurs only if the electric dipole moments of the dye molecules are aligned. We achieved this by heating the film in a strong electric field, thereby giving the molecules kinetic energy and forcing their dipole moments to align. This process is called Corona Poling. The experiment involves watching the second harmonic signal from the film as this process occurs. Second Harmonic Generation is induced by putting the thin-film sample in the path of a nanosecond-pulsed, 1064-nm laser beam. We believe the data provide a measure of molecular alignment, and hence illustrate the Corona Poling process.

A New Advanced Laboratory Project

By Michael Jokubaitis '10

This summer I had the opportunity to participate in the Drew Summer Science Institute and to work with Dr. David McGee, Brian Kelly, and Varun Makhija in the laser laboratory. Having just completed my freshman year, it was an honor and a privilege to be invited to conduct summer research and my experience was both enlightening as well as engrossing.

The objective of my summer project was to begin a study of optics and lasers so that I would have sufficient background knowledge and practical experience to join Brian Kelly in continuing the work on thin-film polymers. The focus of my practical experience was in the construction and testing of several laser kits purchased by the department for use in the Advanced Laboratory.

One laser, in particular, was of interest: an open-cavity Helium-Neon (HeNe) laser. Unlike a typical laser head with a fixed cavity length - the distance between the mirrors - an open-cavity laser has a fixed rear mirror and a movable/adjustable front mirror or output coupler. Since the cavity length of a laser is an integral and essential component in its operation, the ability to vary it at will opens up a fascinating set of possible experiments.

Perhaps the most basic yet most elegant of these experiments is to calculate the speed of light by

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hear a presentation and question-and-answer session by Dr. Bement.

After an introduction by Congressman Frelinghuysen, the ranking Republican representative on the House Appropriations Commerce, Justice, Science, and Related Agencies Subcommittee that oversees the NSF, Dr. Bement discussed the importance of science and science education in America and the role American science will play in the future of this ever-shrinking world. He stressed the necessity for Americans to realize the importance of science and technology and the need to reverse the observed ambivalence the American public seems to feel towards the sciences. In response to a question on women in engineering, Dr. Bement replied "We have not done a good job at telling the social relevance of engineering. We have to sell that relevance...."

Congressman Frelinghuysen supported Dr. Bement's comments by relating observations he made on a trip to China during which he had a first-hand look at Chinese science and scientific education. His conclusions painted a sobering picture. "We're going to get our clocks cleaned if we don't do something with some rapidity," he said. The future is not as bleak as it may seem, however. While other countries, especially Singapore, may be leaders in science education for the K-12 grades, those countries continually send many of their college and graduate students to American universities to learn the scientific investigative and research processes. Thus, while America may seem to lag in science education in the younger grades, our colleges and

universities are very strong.

One vital aspect contributing to the strength of the sciences in American colleges and universities is the relationship that exists between these institutions and private industry: a relationship that provides undergraduates and graduates alike with research opportunities and fosters significant advancements in all fields of scientific endeavor. According to Dr. Bement, "When the business sector is involved, it makes a lot of difference." He was especially impressed by the close relationship that Drew has with several major corporations in the Morris County area, including Wyeth Pharmaceuticals and Roche Pharmaceuticals.

The question-and-answer session lasted for an hour and ten minutes, after which Dr. Bement and Congressman Frelinghuysen toured the laboratories. New Jersey Network (NJN) News was on hand to record both the question-and-answer session as well as the tour of labs. Several of the faculty were also interviewed, and while no one from the physics department spoke on camera, our own Varun "Mac" Makhija was taped while working on his Second-Harmonic Generation experiment in the laser lab. The NJN segment aired on October 17th and opened with a scene of Mac working intently on the experiment while looking very "scientific" in his ThorLabs laser goggles. Though he was not granted a speaking role, it's obvious that, like two masses related to each other by Newton's Law of Gravitation, there is a definite attractive force between the camera and Mac, which begs the question "**Can Bollywood be far behind?**"

An Epic Odyssey to Juniata College

A fable, by Dave Newby '08 and Evan Kimberly '08

(This actually happened! It isn't a fable.- Evan)

On October 19th 2007 Evan, Dave, and Dr. F took an epic journey to the deep, wild heart of Pennsylvania. There we sought to find the legendary Juniata (or, as Dave thought, Juanita) College, and the SPS Zone meeting taking place therein. A Friday afternoon departure and we were off for a 5-hour drive. It just so happened that Mother Nature (and Mother PA Department of Transportation) had some other ideas, as we encountered torrential rains and massive highway construction throughout the entire journey.

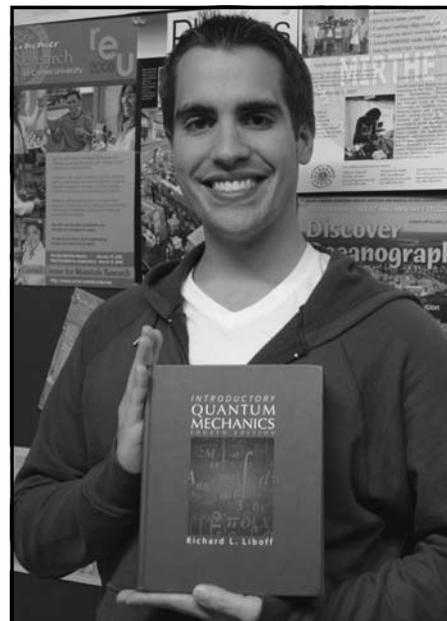
When we finally arrived, we made it just in time to catch the end of a talk about the physics of superheroes, given by the author of the book of the same name, Dr. James Kakalios. After that, we proceeded to check into a hotel that was mostly occupied by fishermen in town for a local tournament. This meant that the entire parking lot was filled with boats, and we had a hard time finding a spot for the Photon since the boats took up several spaces each.

That evening, Evan and Dave partook in some festivities for the SPS students attending the meeting. Here, "festivities" means food, drink, and Guitar Hero at one of the student's apartments. A good time was had by all, and we retreated back to the hotel for a restful night's sleep.

The next morning, we set out once again for the Juniata campus. A day of presentations and poster sessions awaited us, as did a tour of a physics lounge that puts the h-bar to shame. The presentations and posters were quite enjoyable, and Dave won a heavy Quantum Textbook in a raffle.

On the way back, our daring trio stopped by Bucknell to visit young Sara Fenstermacher. Another evening of food and drink followed, and we departed for home shortly thereafter.

Not only was the Juniata zone meeting an excellent way to meet other physics students, but it gave us a delightful tour of the Pennsylvania countryside as well.



Dave got what he always wanted: another quantum textbook.

A Truly Remarkable Theory

By Dr. Ashley Carter

Physics students usually encounter the abbreviation “QED” for the first time in a math text, where it stands for “quod erat demonstrandum,” meaning “what was to be proved.” It’s sort of an expression of triumph following an exhausting effort to show something that’s not immediately obvious.

Later, students come to appreciate that QED is also short for a theory called quantum electrodynamics, surely one of the greatest scientific achievements of the twentieth century. The theory combines three of the major themes of modern physics: quantum mechanics, the concept of a field, and the principle of relativity. It underlies elementary particle physics and provides essential tools for atomic physics, nuclear physics, condensed matter physics, and astrophysics. While quantum mechanics, per se, provided the theoretical foundation for chemistry, it is a nonrelativistic theory and does not deal with the interaction of light and matter.

The British physicist with a French name, Paul Adrian Maurice Dirac, was one of the first to recognize these deficiencies. In 1926 he combined quantum theory with special relativity to describe the properties of the electron. In so doing, he showed that electron spin is essentially a relativistic effect, and he predicted that there must be negative energy states for the electron. Out of the theory emerged the idea that there must exist a positively charged electron. When the positron was discovered in 1932, Dirac was awarded the Nobel Prize for having added a dimension of matter to the universe – namely, antimatter.

Another prediction of the Dirac theory is that the magnetic moment of the electron is twice the classical value for a spinning charged particle placed in a magnetic field. Dirac’s value was exactly 1 in certain units. Then in 1948 it was discovered that the actual number was closer to 1.00118 with an uncertainty of about 3 in the last digit. It was known that electrons interact with light, so some correction was expected. But when the correction was calculated, the result was infinity!

All of this got straightened out by Julian Schwinger, Sin-Itiro Tomonaga, and Richard Feynman, who launched the theory that came to be known as quantum electrodynamics. To make a long story short, a recent experimental value of the electron magnetic moment is 1.0011 5965 221 with a possible error of 4 in the last digit. QED puts it at 1.0011 5965 246 with an uncertainty of 20 in the last digits. Feynman liked to point out that if you were to measure the distance from New York to Los Angeles to this accuracy, it would be exact to within the thickness of a human hair. That’s how carefully QED has been checked in the past sixty years! How can one not be intrigued by a theory like that?

So I’m really looking forward to offering a two-credit course in the spring semester that might be called “Advanced Quantum Mechanics.” The course arose from a request by four senior physics majors who asked to be exposed to “more quantum” after they had taken Physics 120 with Dr. McGee last year (my compliments to him for stimulating their interest). We will study perturbation theory, scattering theory, and relativistic kinematics, all as a prelude to taking up Dirac’s theory of the electron. We will talk about Feynman diagrams and Feynman rules, and a little particle physics. We can only scratch the surface of QED; it’s a subject usually taught to third-year graduate students. But it will give us some feeling for what is called the standard model, the cornerstone of contemporary physics. And we will be able to appreciate how a non-sensical answer of infinity was superseded by a calculation that agrees with experiment to within ten significant figures.

The GRE: Mac, Dave, and Evan. A Dialogue, In One Act

By Varun “Mac” Makhija ‘08, Evan Kimberly ‘08, and Dave Newby ‘08

Mac: “What were you guys actually thinking while doing it?”

Evan: “It was fun. The test itself wasn’t bad. Preparing was awful.”

Dave: “I agree.”

Mac: “This is Awful! Dave, let’s not do this as a conversation.”

On November 3rd, 2007, four Drew physics majors and one physics alum set out to conquer that epic evaluation, the physics GRE (And they all failed. –Mac). For any of our loyal readers who may not have heard of the physics GRE, think of it as a final for every physics class in the undergraduate curriculum, distilled into 100 multiple-choice questions to be completed in 2 hours and 50 minutes. A minimal sheet of constants accompanies this exam, with no calculators or breaks allowed. All that stands between you and imminent failure is a number two pencil and your wits. (Stop making it so dramatic! Why are you making it so dramatic? –Mac)

Laura drove all the way to Delaware to take the test in the midst of frisbee madness, Mac ventured unwittingly to the Big Apple (Please mention that I woke up at 5:00 am and had a wonderful time at NYU, barring the car alarm that went off right outside the window when I started the %[^]#ing test. - Mac), and Dave, Evan and Ethan dove into the depths of Newark at Rutgers. (Why do you have to make it so dramatic? – Mac)

Having spent several weeks preparing, we all seem to agree that the test went well. More seriously, we all spent several

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NOTES FROM THE OUTSIDE



By Dr. Len Feldman '61

My wife Betty (C '63) and I have returned --to New Jersey! It has been an interesting path and I welcome the invitation to use this Newsletter catch up with the Drew Physics community.

As you know I was born and raised in the Bronx and, in the words of my parents, "headed west" to attend undergraduate school at Drew, in Madison, New Jersey. My original pre-med aspirations were quickly blown away after my first physics course with Prof. John Ollom. I simply loved it and redirected my career path. This was in 1958, the era of the "race for space", when there was great emphasis throughout the country for more scientists and engineers. So the times, and the Drew environment, matched beautifully and I majored in physics at Drew. I have never had second thoughts about that decision.

Simply put, I learned the physics basics from John Ollom—and, most importantly, the tremendous advantage of knowing the basics. That prepared me to move in different physics fields, talk to a broad array of physicists and live in our wonderful physics community!

Graduate school was at Rutgers University, where I started in experimental nuclear physics. But the apparatus and accelerators of nuclear science were of greater use than simply nuclear—a lesson that I have seen repeated many times. Individuals with insight and imagination can see scientific connections across boundaries and open up entirely new fields. In this case Bell Labs, primarily a laboratory of solid-state science, saw new possibilities in condensed matter science with nuclear techniques. Bell joined Rutgers in the establishment of a nuclear science laboratory, and I finally did my Ph.D. under the direction of Bell Labs scientists, bridging condensed matter science and nuclear physics. This experience of scientific interdisciplinarity had a strong effect during my entire scientific career.

For the next 29 years (yes 29!) I worked in the basic research area at Bell in a variety of scientific areas. In 1967 Bell Labs was a wonderful place, full of amazing scientists and a commitment to high quality basic research. On my first day I had lunch with Nobel Prize winner Shockley, and during my time at Bell I met at least six other Bell Labs Nobelists, and a host of other superb scientists. Most importantly I was fortunate to receive excellent mentoring---extraordinary role models all around me. I also learned that different qualities were required to be a good scientist and a good mentor---very few individuals have both! But I was fortunate to be close to a few.

Bell Labs at that time was as close to a University atmosphere as possible, in a corporate setting. I was even able to obtain a "sabbatical", with a year spent at Aarhus University in Denmark, a laboratory with extraordinary strength in my scientific field. In the traditions of Bohr, the Danes had a deep and insightful approach to physics, which I tried to learn. It was a wonderful year and my wife Betty and I retain strong friendships with our Danish colleagues which have lasted throughout the years. The combination of mentoring at Bell and the Danish approach to science completed an excellent overall scientific education for me— text-book fundamentals from Drew University and research approach from my early mentors at Bell and in Den-

mark.

I remained at Bell until 1996, leaving as Department Head, Silicon Materials Research Department. Slowly, but surely, I had become an applied physicist and enjoyed it immensely. In a nutshell an applied physicist takes his/her physics knowledge to a real problem, one in which there is a great need and challenge. It is exciting to work on problems in which you interact with many colleagues and influence a field that is changing mankind—in this case the silicon revolution. The science challenges were still demanding, but the team aspect was new and great fun! Fundamentals were even more important---new problems emerged quickly and the basics of physics were an underpinning that allowed one to contribute quickly and confidently.

In 1996, before the demise of the Labs, I chose to leave Bell and accepted an academic position at Vanderbilt University, Nashville, Tennessee. I simply wanted to try the academic life. Culture shock, physics shock, equipment shock, and academic shock were all in my mind. Can I teach? Can I do research outside of comfortable Bell? Can the caliber of colleagues approach the glorious Bell contingent? Could I build a laboratory? We came through okay---even with the country music-- and in the long run I thoroughly enjoyed it! Truthfully, physicists live in an exciting world, around smart and well-meaning people, who make our professional lives rich—wherever—Tennessee or New Jersey.

At Vanderbilt, and in the early 2000's, scientific interdisciplinarity was a popular and important concept. I led the establishment of a new institute, the Vanderbilt Institute of Nano-scale Science and Engineering (VINSE). It consisted of representatives from Chemistry, Electrical, Mechanical, and Biomedical Engineering, and of course, Physics and Astronomy. On the whole it worked well---new facilities, new graduate programs, extraordinary research, all in an environment that was breaking the "stove pipe" picture of academic departments. Subconsciously, I was probably trying to make Vanderbilt look like Bell, which was the epitome of interdisciplinary science.

As it turned out Rutgers University was seeking to establish such an institute within its university structure. So in 2007 for a variety of family reasons, Betty and I returned to New Jersey. I now do interdisciplinary science in New Jersey, helping Rutgers establish its institute. As always it is new, with some tough challenges and some moments of exhilaration as we hire and mentor young PhD's and watch their progress. One of the positives for us of course, is to again be in the Drew area and to be able to socialize with the Fenstermacher's and other Drew friends.

There is no real life lesson I can glean other than to note that it is grand to be within the physics community and to have earned a Ph.D., so I can experience these different professional activities. For me it started with inspired lectures in basic physics at Drew.

Albert Vinicio Baez

1912-2007

Albert V. Baez, physicist and father of Joan, died at the age of 94 on March 27, 2007 in Redwood City, CA. Dr. Baez was a member of one of the first classes of the College of Liberal Arts, or Brother's College as it was called then. He was the son of a Methodist minister and considered studying for the ministry himself, which must have made Drew attractive at that time. But he turned toward mathematics and science, and received his B.A. in mathematics in 1933. This was followed by a masters degree in physics from Syracuse University, and eventually a Ph.D. in physics from Stanford University in 1950.

As a graduate student working with his professor, Baez developed the x-ray reflection or grazing camera used in medicine and astronomy, and later developed diffraction zone plates for the focusing of x-rays.

His experimental expertise was in high demand during the arms race buildup of the cold war, but his Quaker pacifist beliefs led to a different career in education and humanitarianism. He worked for UNESCO (United Nations Educational, Scientific, and Cultural Organization) establishing a physics department and laboratory at Baghdad University in Iraq. He taught and did research at a number of schools including MIT, Harvard, and Harvey Mudd College. He was the author of several books including *The New College Physics: A Spiral Approach* in 1967, and he made over 100 physics films for the Encyclopedia Britannica Educational Corporation (some of which I'm sure we have viewed here at Drew).



Dr. F and Dr. Baez in 1991

Over the years Dr. Baez made many trips to Drew, serving on several science planning committees, and receiving a Doctor of Humane Letters honorary degree at commencement in 1991. He enjoyed receiving *The Dilated Times*, and corresponded with us on several occasions.

In retirement he led an organization to help bring better conditions to impoverished Mexican villages. Dr. Baez is survived by his wife, Joan Bridge Baez, and two of his three daughters. Drew will miss one of its most well-known physicists.

- Bob Fenstermacher

The GRE, continued from page 7...

weeks reviewing every physics class that we've taken at Drew, from Phys 11 all the way up to E&M. The GRE covers every physics subject, and though there are strategies for succeeding since it's multiple choice, there is no substitute for some old-fashioned studying. We were also well prepared by the practice tests supplied by the department in the h-bar.

For any undergraduates who have not yet taken the test, we suggest that you begin studying right this moment, regardless of your year. Really, put this down and start studying. Right now!



Editor's Note: While from this dialogue the reader may come to the conclusion that those physics students who took the GRE on November 3rd failed it, that is, in fact, not the case. Actually, the results from the GRE will not be known until after this edition of the Dilated Times goes to print.

However, never fear. The editor assures you that all will be revealed in the spring edition, at which time plaudits or obituaries will be awarded accordingly.

Physics Business Cards Revisited

Thanks to our alums, students and visitors have enjoyed learning of the many varied career paths represented by the business cards that are in the Physics Careers display in our hallway cabinet. But time marches on; new alums are now part of the growing family and some older alums may have changed jobs or still wish to participate. I invite you to look in your desk drawer or your wallet, pull out a business card and then remember to send it to me for our display. No note is required; just drop in an envelope and send to Bob Fenstermacher, Department of Physics, Drew University, Madison, NJ 07940. All of us in the department thank you for this contribution (only \$0.39 and tax deductible!)

New Project, continued from page 5...

adjusting the length of the laser cavity and measuring the beat frequency between wavelengths resonating in the cavity. From fundamental theory and algebra, a beautifully simple relationship between the beat frequency, the cavity length, and the speed of light emerges

$$\nu = \frac{c}{2L}$$

where ν is the beat frequency, L is the cavity length, and c is the speed of light. With a digitizing oscilloscope performing an averaged FFT and this relationship, I was able to measure the speed of light as 3.01×10^8 m/s, or approximately 0.40% above the accepted value of 2.998×10^8 m/s.

The purpose behind my conducting this research was twofold: one, it provided me with a firm foundation in optical principles and laboratory procedure – a foundation upon which I continue to build with an Independent Study during this semester and next – and two, a new Advanced Laboratory project has come out of it that will hopefully be an instructive tool to be used during that course in the future.

This project was rewarding and made me recognize again why I want to study physics. The idea that with nothing more than a laser tube, a mirror, and an oscilloscope one can measure so fundamental and important a physical constant as the speed of light boggles my mind. Thank you especially to Dr. McGee for giving me this opportunity, to Brian and Mac for showing me the ropes, and to Mr. William Clark for funding.

Upcoming Events:

December 11th:

Annual Holiday Taco Party at Dr. Fenstermacher's House. Come enjoy tacos, physics caroling, physics gifts, and the festive spirit.

January 18-23, 2008:

SPS Research Session AAPT Winter Meeting, Baltimore, MD. SPS Road Trip. Details to follow.

Don't forget to visit the physics department website at:

<http://depts.drew.edu/phys/>

The Dilated Times

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Address Correction Requested

Inside...

A Welcome to Dr. Murawski, Plasma Physics at Princeton, The saga of the Physics GRE, The Odyssey to the Juniata SPS zone meeting, Summer research, Remembrance of a legend, and much, much more!

Contributors...

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